UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Engineering

RESEARCH IN MECHANICAL PHASES OF COTTON GINNING

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(Paper delivered before Arkansas State Ginners' Association at Hot Springs, Ark., July 20, 1933.)

Although it has been our pleasure to have had many of you as visitors to the United States Cotton Ginning and Fiber Laboratories at Stoneville, Miss., the majority of ginners must be reached through their respective associations and trade publications. With the permission of those ginners who have been to Stoneville, I would like to take a moment of your time to first tell you how the Government is prepared to study the mechanical problems of cotton ginning. Mr. Gerdes will describe to you how the Government handles the problems of cotton quality arising from our work.

In 1930, by an Act of Congress, the cotton ginning investigations were established under the direction of the United States Department of Agriculture; suitable laboratories were constructed and machinery purchased to outfit both the necessary shops and experimental ginning set-ups.

Our equipment now comprises a very complete machine shop, sheet-metal shop, carpenter shop, an experimental ginning plant, and a standard delinting outfit. Electricity is being used for power, and seed cotton is being brought fresh from the cotton fields of most of the Southern States.

In the experimental ginning plant we have at present thirteen distinct gins, seven cleaning-feeders, five unit extractors, three cylinder cleaners, two airline cleaners, four separators and a pneumatic elevator, a Government design of vertical drier with two arrangements for feeding same, and a hundred-bale cotton house for storing such cotton as may not be lined up for immediate ginning.

The Government recognizes that the world markets for American cotton are seriously affected by continual reports of inferiority in ginning, and by insistent demands from home mills that the quality of the ginned fiber be improved. I cannot say to what extent this condition of affairs has been influenced by unwarranted propaganda, but the Department of Agriculture has obtained the latest British-made roller gin with which to compare its products and those of our gins, and we are alert to investigate important statements reflecting upon American ginning. The Government further recognizes that heretofore there has been no impartial or unbiased source of information open to ginners; and yet the ginners were being held responsible for the quality of the ginned crop. Hence, as you all probably recall, there was ample justification for the Government entering into the field of cotton ginning research.

In the cotton ginning investigations, the problems of the ginner are attacked in a logical sequence. If a ginner is to improve his ginning, he must learn certain fundamental facts, such as how simple may his machinery be, how much capacity must he have to obtain best operating conditions, how fast can he gin without damage to quality, etc.

As a matter of fact, the cotton ginning investigations are indicating that these problems must be decided upon sectional lines--each section or locality facing certain questions and problems that are peculiar to that part of the country. Arkansas ginners are not dealing with the conditions in the Carolinas, and must use machinery combinations to meet Arkansas conditions.

From preliminary statistics obtained by surveys of ginning plants across the Cotton Belt, Figure 1 illustrates the machinery combination which about 50 percent of the Arkansas plants use. There are two improvements which we would suggest in this combination, if the Arkansas ginners are to obtain the best out-turn and quality combined.

First, we would recommend some kind of a drier as being necessary to insure smooth ginning under variable conditions of moisture content in the seed cotton and during adverse weather. The Government Process, as promulgated by the Bureaus of Agricultural Engineering and Agricultural Economics of the Department of Agriculture, has been proved to be safe and successful in handling thousands of bales of damp cotton. It is no longer an experiment. Today your own state is one of the most progressive in this advancement in ginning, and one can find cotton driers in many ginning plants, especially near the Mississippi River.

The large manufacturers of cotton ginning machinery and accessories are offering drying equipment which is the result of careful design and adherence to the Government requirements. The assistance which the cotton ginning investigations have afforded these and other concerns is but an example of the indirect help which the Government is extending to the ginners in this work.

We cannot stress this need for driers too strongly, because it is an important step in relieving the ginner of chokages, slow operation, tight rolls and other troubles which invariably result from attempts to gin damp cotton. Mr. Gerdes will show you some very interesting results in the quality improvements resulting from drying, and I wish to take this opportunity to acknowledge the indebtedness which we owe him for having persistently and thoroughly brought these facts to light.

By the use of adequate drying equipment, you can either gin faster on the one hand, or with a looser roll on the other, all under conditions which would prevent operation if you had no drier.

Now, the second big change in this typical Arkansas diagram, as we see it, is the introduction of suitable unit extractors in place of the cleaning feeders. We do not say that this is absolutely necessary, because it is not where hand-picked cottons are involved. But if you have a drier, and if you encounter rough cottons during the final portion of the ginning season, then by the use of a unit extractor you are in a position to successfully meet your worst conditions.

The Government recognizes that the use of extractors may afford farmers an excuse for rougher harvesting. This should be discouraged, because clean hand-picking is one of the necessary essentials to highest quality; and when the country awakens to the evils of "hog-round" buying, with which you are already familiar, the farmer will demand and receive rewards for quality. It is not my place to discuss the evils of present marketing conditions in some sections of our country, but they impede the improvements in ginning plants by nullifying the profits which should be returned to the ginner and planter.

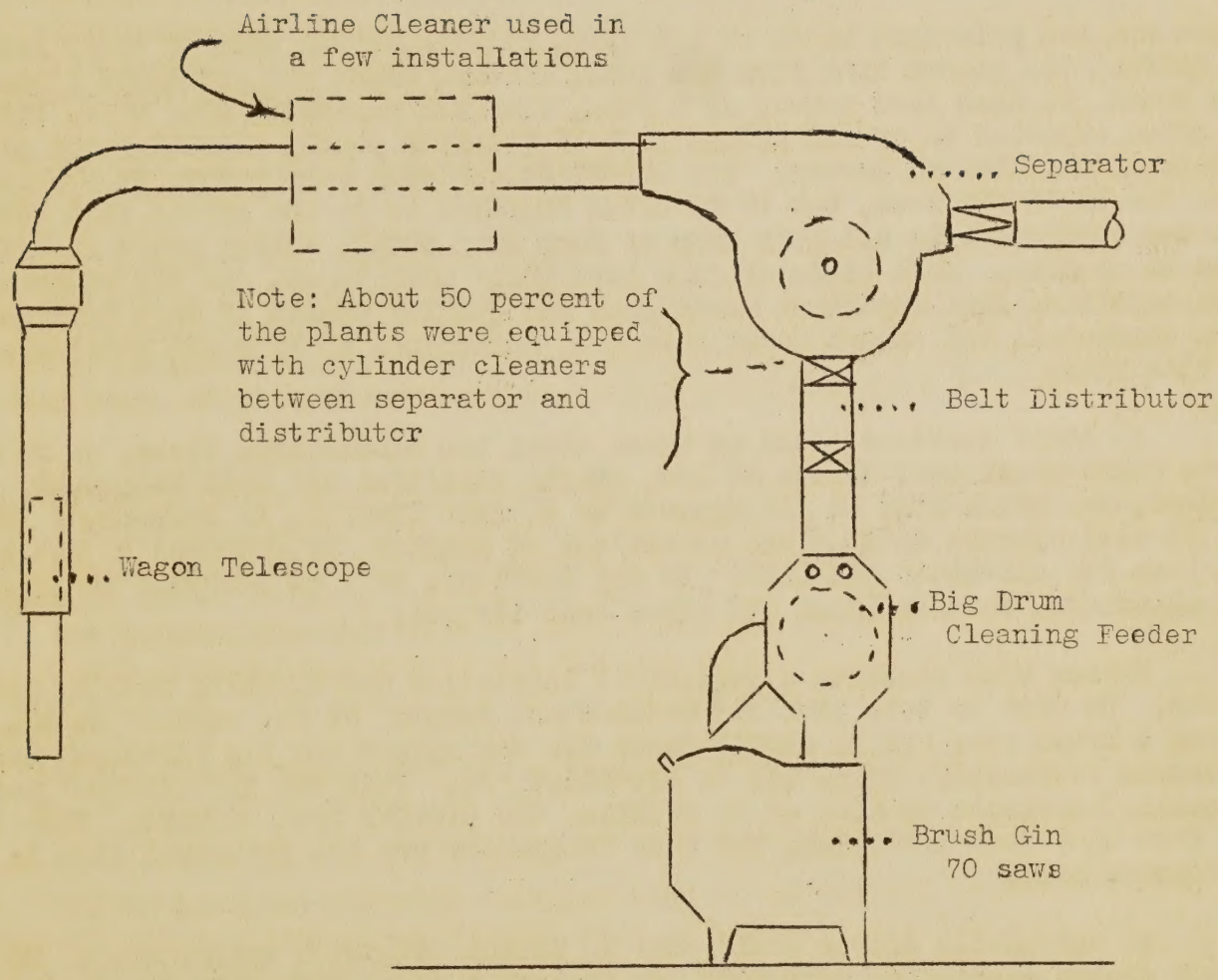

Figure 1.- Diagram illustrating an average Arkansas cotton ginning plant, as tabulated from 42 gins covered in a Grade & Staple Office survey of 1930-31.

The power requirements for operating unit extractors are about the same as needed for cleaning feeders, so that the use of these units does not build up an appreciable increase in operating costs.

Having suggested to you two possible improvements in your typical plant arrangement, let us consider some mechanical phases of ginning which are vital to profitable operation. The ginner faces three serious problems when he starts out, namely:

(1) Installation cost, or simplicity versus complexity in his machinery.
(2) Operating expenses, or capacity versus cost of operating.
(3) Good results, or quantity versus quality.

We have touched upon the matter of installation already, in so far as certain suggested changes in conditioning and handling machinery are involved, but we have more to consider with regard to the question.

There are two principal kinds of saw gins, distinguishing them by their means of doffing the ginned lint from the saws, namely, brush and air-blast gins. The brush gin uses less power, as a rule, than the air-blast kind does, but it is often objected to on the ground that it requires yearly attention and protection from rats and vermin. The air-blast gin uses more power, as a rule, than the brush gin does, but it is often objected to on the ground that adverse weather combined with slightly damp or damp long staple cotton makes it difficult to operate. Both kinds of gins have their advantages, and the Government investigations into important mechanical and quality phases of each have not been completed, but enough facts have been determined to be worth mentioning at this time.

In humid sections, such as those along the Mississippi River, or in sections where moist seed cotton of long staple varieties are most frequently handled, the brush kind of gin appears to be more flexible in operation. That is, it will operate under worse conditions of weather and dampness in the cotton than the air-blast gin will. In dry sections, such as portions of Texas and elsewhere, the air-blast gin comes into its own.

Either kind requires a periodical inspection and checking over by the ginner. He must be sure that his brushes are running at the correct speed, if he has a brush gin; and he should check his fan speeds and his air-blast nozzle pressures frequently, if he has an air-blast gin. Fans are the greatest power consuming criminals we know of in stealing the profits from ginners. They do not show what they are doing, but they frequently are the principal item in your power bill.

No automobile driver would care to travel without a speedometer. No ginner should operate an air-blast gin without a speed indicator and an air-blast indicating gauge. I have here a Government air-blast indicating gauge which will show you what your pressures at the nozzles are. You can make up such a gauge yourself for about one dollar.

If ginners will make use of a speed indicator and such a gauge, they can keep their air-blast gins running economically and at the same time they can improve the quality of their ginned lint in many instances.

While we are on the subject of fans, the Government surveys have disclosed items which the ginners should also give serious consideration to. If you were told that blowing seed with a fan cost you ten times as much as moving it with a rotary augur, you would stop such a cost at once. Yet many gins adhere to seed-blowing practices and are actually blowing an important share of their profits away. Another item of loss of profits may be found in incorrect piping for your fans and apparatus. In many gins, when the stands are idling, the fans are hogging the air through a control valve which opens behind the separator and allows the air to short circuit around the suction pipe. Such valves are profit thieves, and should be replaced by circular dampers so that cutting off the fan suction will at the same time cut off the flow of air. A fan handling no air does not use much power.

We are bringing these things to your attention because accountants and cost finding bodies are continually telling you that you are losing money on ginning by not charging enough. One objective of the Government cotton ginning work is to tell you how you can reduce your operating costs without cutting down on your capacity.

Therefore, in this first problem of complexity versus simplicity in your ginning layout, the ginner should not be deceived by apparent simplicity. He may have only one fan, but it may be the worst profit thief he could find. He may buy it only once, and yet be paying for it all his life without knowing it. If you prefer an air-blast kind of gin, give it a chance to prove its merits by using instruments to check it with. Assist it by supplying dry cotton to it, and neutralize adverse weather conditions by carrying dry air to the air-blast supply, either by using a heater or a dehydrator.

In the question of operating capacity versus operating costs, it is more profitable to have your gin stands working at normal loads rather than to have too many stands and allow the last one to dribble along. If you can maintain a constant load upon a few machines and can assure yourself of a satisfactory operation of those machines, you are in the best position to make money in the cotton ginning venture.

The existing designs of cotton gins of all kinds do not permit a heavy feeding of the gins and a maintaining of quality out-turn at one and the same time. Thus, commercial ginning plants are faced with the necessity of turning out a definite number of bales per hour if they are to avoid bankruptcy, and to do this they must, to a certain extent under existing designs, sacrifice quality in order to obtain out-turn. Mechanically, these different designs of gins have very interesting differences in their power consumption.

The brush types of gins in these tests show relatively less power differences between their loose seed rolls and tight seed rolls than air-blast gins do, but as a rule, the speeds recommended by the manufacturers are the best to follow from the standpoint of power consumption. We are asked frequently whether or not it is advisable to speed up the saws in order to obtain a greater turn-out, but in the majority of cases increase of speed requires increase of power without producing equal increase in capacity.

Tables 1 and 2 illustrate two cases where we tested three air-blast gins and three brush gins, using Missdel No. 7376 cotton 1-1/8 inches in staple. They show the average electrical horsepower input for 70-saw stands, and also show the pounds of lint ginned per saw per hour. With the loose seed rolls in the air-blast gins, there was some difference in power consumption,

but the tight seed rolls appeared to be very similar in their power requirements for the three makes of gins. The lint yield was lower for the loose roll conditions than for the tight roll conditions. In the air-blast gins the loose seed roll turn-out was only about 60 percent of the tight seed roll turn-out at the same saw speeds. With the brush gins there was not so great a difference found in turn-outs between the loose seed rolls and tight seed rolls at each speed, although the loose roll generally produced better quality in the samples for both brush and air-blast gins.

Table 1.- Horsepower input per 70-saw gin and pounds of lint ginned per saw per hour, with loose sed roll - averages for three makes of brush gins and three makes of air-blast gins.

(Missdel No. 7376 - 1-1/8 inch staple)

Speed of saws R.P.M.	Horsepower input, per 70-saw gin		Pounds of lint, per saw per hour	
	Brush	Air-blast	Brush	Air-blast
400	16.5	15.2	4.2	5.6
500*	17.4	17.0	4.2	5.8
600	18.3	18.1	4.2	5.1
700		18.8		5.8

*Average at 500 R.P.M., loose roll: Brush gin 2.48 HP per 10 saws
Air-blast gin 2.43 HP per 10 saws

Table 2.- Horsepower input per 70-saw gin and pounds of lint ginned per saw per hour with commercial tight seed roll - averages for three makes of brush gins and three makes of air-blast gins.

(Missdel No. 7376 - 1-1/8 inch staple)

Speed of saws R.P.M.	Horsepower input, per 70-saw gin		Pounds of lint, per saw per hour	
	Brush	Air-blast	Brush	Air-blast
400	17.9	18.4	6.1	9.2
500*	20.1	20.5	6.2	9.2
600	21.0	21.0	7.0	9.2
700		22.8		9.5

*Average at 500 R.P.M., tight roll: Brush gin 2.87 HP per 10 saws
Air-blast gin 2.93 HP per 10 saws

(The above tables include power which was consumed by independent variable speed shafting, employed for driving the saw cylinders, and constant speed shafting, employed for driving the feeders. Present day 70-saw gin stands do not alone consume the amount of power indicated above.)

Averaging for the three brush gins, the power on tight seed rolls increased 3.1 horsepower, or 17 percent, with the increase from 400 to 600 R.P.M. in the saw speeds, while there was a 14 percent proportional increase in out-turn of ginned lint, so that the ginner would not ordinarily be warranted in making an excessive increase in the speed of his saws. The air-blast types of gins generally showed a slightly lower lint yield for loose seed rolls than for tight seed rolls, in percent of the total weights of the seed cotton handled; but this did not always hold true for the brush types of gins, as we frequently found examples, particularly at the higher speeds, where the lint yield of brush gins was less for tight seed rolls than for loose seed rolls, which may have been due to the fact that the excessive pressure within the roll caused a discharge of some of the seed cotton into the seed trough before the seed had been thoroughly cleaned.

You will note that in these tests of horsepower and pounds of lint per saw per hour the air-blast gins gave the highest out-turn. From our observations, air-blast fans often require one horsepower for every ten saws, but this may be reduced in certain installations which are carefully laid out and for which the speed readings and nozzle pressures are observed with instruments as previously described. We contend that it should be possible to reduce this to 5/8 of a horsepower for each 10 saws.

Frequently we have been asked whether it would be advisable to use plain single-rib gins when a ginnery is equipped with good extracting machinery. Our experiences in this matter are that when the saws are protected by the extractors, it is entirely feasible to use plain single-rib gins instead of double-rib huller types of gins, if the ginner will keep his seed roll cleaned out by dumping it as soon as it begins to become trashy. Probably the plain gin will gin faster and require somewhat less power than the double-rib huller types will, but on the other hand we do not believe that it is advisable to discard the double-rib huller types in the State of Arkansas, because the huller fronts throw out many burs, leaf stems, and other particles of foreign matter that even the best of extractors may allow to pass through, especially when the extractors are running at full capacity.

As we have previously pointed out, unless care is taken to put the incoming seed cotton into a dry condition, either by the use of driers or other means, it is almost impossible to guarantee a high quality of ginned lint and at the same time maintain a fast rate of ginning. Where ginners handle their own cottons and can afford to take the paind to safeguard the quality of their ginned lint, the loose seed roll and moderate rates of feed combined with clean, hand-picked, dry cotton present the best means we know of for obtaining a high quality sample, and Mr. Gerdes will take this up from his point of view.

The seed cotton must come to the ginner in the best possible condition if he is to produce his best results, and he should not be held responsible for cotton that is poor, trashy, or damp to begin with. No ginner is a magician or a "cure-all" for some cottons. Bring him clean cotton, give him a good drier, let him do the work without crowding, and the quality of the American cotton crop, so far as the machinery is concerned, will be improved.

Another question which is frequently asked concerning the testing work is with regard to the effect which new or worn saws, or new or worn ribs, have upon the ginning. We have not completed the series of tests which have been outlined in our work, and I cannot at this time fully answer the question for you, but is is quite clear that worn ribs and worn saws have decreased the lint yield as high as 4 percent in some of our tests, and we believe that this is an important indication of what we may find in subsequent studies.

Looking forward in the Government's plans to assist the ginner, a study of the entire power question may, in all probability, follow our immediate work within the gin stand proper. Under the farsighted and able leadership of Mr. McCreary, who is the official executive in charge of ginning machinery and engineering activities, we expect to investigate the fields of power such as electric, diesel, gas or gasoline engine, and steam. Just as our previous investigations are lighting the way toward solving the question of what ginning machinery is best adapted to any given cottons or locality, so should the power studies assist the ginners in the field of mechanical operation.

But, finally, the ginners must endeavor to improve the quality of the American cotton crop by adopting the best practices and methods, because the public will then be willing to adjust itself to justifiable charges commensurate with the services rendered. The cotton grower can only hold his place in the markets of the world by obtaining from the ginner the highest quality of service, for which the ginner must be paid.

May I not thank you for the courtesy you have afforded me to present this brief paper.